

COMPREHENSIVE REVIEW ON ANTI-OXIDANT ACTIVITY OF PLANTS

Muhammad Riaz ur Rehman¹, Syed Muhammad Ali Shah¹, Maisam Ali Shahid², Nabila Akram³, Muhammad Mudassar Ashraf¹, Imtiaz Mahmood Tahir⁴, Tahir Aqeel⁵, Hamad Ahmed¹, Rizwan Asif¹, Ahsan Sarwar⁶

ABSTRACT: Medicinal plants are becoming popular as anti-oxidant agents. The present review has been prepared with an objective to compile exhaustive literature on pharmacological reports on anti-oxidant plants. An attempt has been made to incorporate different plants responsible for anti-oxidant activity. The review has been compiled using references from major databases like Chemical Abstracts, Medicinal and Aromatic Plants Abstracts, PubMed, Scirus, Google scholar, Open J Gate, Scopus, Science Direct and Online Journals. A survey of literature revealed that extracts/fractions/isolates from medicinal plants from various systems of medicine have been reported to possess anti-oxidant activity. Medicinal plants having antioxidant activity have been documented. Such plants need to be explored properly with a view to isolate anti-oxidant constituents, and to evaluate their possible mode of actions so that these plant drugs could be exploited properly as potential anti-oxidant agent.

1. Department of Eastern Medicine and Surgery, Directorate of Medical Sciences, GC University Faisalabad, Pakistan
 2. Department of Urology, Allama Iqbal Medical College, Jinnah Hospital, Lahore, Pakistan.
 3. Department of Pathology, Avicenna Medical College Lahore, Pakistan; and University of Health Sciences, Lahore, Pakistan.
 4. College of Allied Health Professionals, Directorate of Medical Sciences, GC University Faisalabad, Pakistan
 5. Department of Pharmacy, University of Lahore, Islamabad Campus, Pakistan.
 6. Department of Pathology, University of Agriculture, Faisalabad, Pakistan.
- *Corresponding Author Email: SMAS (smalishah@hotmail.com)

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INTRODUCTION

Antioxidants are involved in protection of organism from reactive oxygen species (ROS). The oxidation induces cell membrane disintegration, membrane protein damage, and DNA mutation, which can lead to cancer, hepatic cell injury and cardiovascular diseases [1]. Therefore, there is need to find out antioxidants from natural products [2]. Antioxidants have phenolic flavonoids that scavenge oxygen radicals and are involved in inhibition of enzyme activity. Various methods are available for measuring the antioxidant activity of natural products. Most commonly used method is DPPH radical scavenging assay to measure radical scavenging activity [3-5]. There are thousands of compounds that have antioxidant chemistry *in vitro* and appear to have some antioxidant effect *in vivo*. Antioxidant scavenging of radicals is actually a competition between all organic molecules

Because the rate constants for these reactions are usually very close to each other. Thus, for a molecule to be effective as a free radical scavenger, it would need to out compete all other molecules. Vitamin E is concentrated in membranes where it reacts with hydroperoxyl radicals. Scavenging of superoxide, hydrogen peroxide and other hydroperoxides is carried out efficiently by enzyme catalyzed reactions with rate constants that are 100,000 times faster than for the non-enzymatic reactions. Several investigations on medicinal plants in all over the world have indicated that active ingredients in medicinal plants exhibit powerful antioxidant activity. In previous studies (Table 1), various medicinal plants have been tested from different species belonging to different families traditionally used for the treatment of cardiovascular disorders.

Scutellaria baicalensis

Family: Lamiaceae, **Part used:** Roots. **Study:** *Scutellaria baicalensis* is a Chinese medicine that is very famous in USA. Its efficacy as antioxidant has been reported. If this medicine is combined with grape, both exhibit the activity as synergistically. Both are involved in scavenge ROS. Because both in combination increase antioxidant activity therefore it can be used in lower doses as compared to single drug. Side effects exhibited by single drug use can be minimized by this way because in combination toxicity level of these medicines will not be available [5,6].

Convolvulus pluricaulis

Family: Convolvulaceae, **Part used:** Whole plant. **Study:** Nahata *et al.*, has reported in vitro antioxidant activity of ethanolic extract of *Convolvulus pluricaulis* [6]. In another study, methanolic extract has been investigated by using 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging model. Standard agent was ascorbic acid. Methanolic extract exhibited significant antioxidant activity. IC₅₀ value of ascorbic acid was 2.03 µg/ml and 41 µg/ml was of methanolic extract [7].

Sonchus oleraceus L.

Family: Asteraceae, **Local name:** Socnhal. **Parts used:** Leaves and root. **Medicinal uses:** It is used in ascites, hydrothorax and indigestion. **Pharmacological activity:** It is febrifuge and vermifuge. **Study:** Antioxidant and cytotoxic activities of *Sonchus oleraceus* L. extracts have been reported. This study was conducted in vitro. DPPH, hydroxyl radical-scavenging activity was used for study. Methanol extract was more active than ethanol extract of plant. The antioxidant activity of this plant was dose dependent. Phenolic and flavonoids contents were found in methanol extract of this plant. This study showed that plant extract is natural anti-oxidant [8].

Acacia catechu

Family: Fabaceae, **Parts used:** Seeds, bark. **Medicinal uses:** It is used in cough, diarrhea, boils and eruption of skin. **Study:** Antioxidant activity of *Acacia catechu* has been reported. Methanol extract was used for anti-oxidant activity. Methanol extract was further fractionated. Ethyl acetate fraction was found highest anti-oxidant agents. It presented lower EC(50) values in DPPH radicals (4.76 ± 0.14 µg/mL) [9].

Cissampelos pareira L.

Family: Menispermaceae, **Local name:** Buddibel. **Part used:** Root. **Medicinal uses:** It is used in diarrhea, cough, dyspepsia, dropsy and urinary complaints. **Pharmacological activity:** It is stomachic and purgative. **Study:** Antioxidant and immuno-modulant activity of *Cissampelos pareira* Linn has been reported. The alkaloidal fraction of this plant was screened for *in-vitro* antioxidant activity. Rats were selected for study. Alkaloidal fraction of this plant showed strong antioxidant activity that was evident from its ability to scavenge the stable free radical DPPH. Alkaloidal fraction inhibited lipid peroxidation in rat liver homogenate [10].

Rumex crispus

Family: Polygonaceae, **Part used:** Root, fruit. **Medicinal uses:** It is used in skin infections, tumors, gall bladder problems, ulcers, swellings of glands, anemia, jaundice, hepatitis, piles and wounds. **Pharmacological activity:** It is laxative, tonic and anti-anemic. **Study:** Antioxidant activity of *Rumex crispus* L. fruit extract has been reported. The methanol extract of this plant was used for study. Extract inhibited the CCl(4) -induced oxidative stress. This effect was in a dose dependent manner [11].

Taraxacum officinale

Family: Asteraceae, **Parts used:** Leaves and root. **Pharmacological activity:** It is diuretic. **Study:** Colle *et al.*, has reported

that antioxidant properties of *Taraxacum officinale* leaf extract. Study was conducted to investigate the hepatoprotective activity of this plant against APAP-induced hepatotoxicity. Thiobarbituric acid was decreased. Liver enzymes levels were decreased by use of extract at dose of 0.1 and 0.5mg/mL. This plant also exhibited *in vitro* anti-oxidant activity. This study showed that plant has hepatoprotective activity against toxicity induced by APAP [12].

***Solanum nigrum* L.**

Family: Solanaceae, **Local name:** Kachmach. **Medicinal uses:** It is used in cirrhosis of liver. **Pharmacological activity:** It is diuretic, laxative and antispasmodic. **Study:** Heo *et al.*, reported the anti-oxidative effects of glycoprotein isolated from *Solanum nigrum* L [13].

Terminalia macroptera

Family: Combretaceae, **Part used:** Leaves. **Study:** Pham *et al.*, has studied the anti-oxidant activity of *Terminalia macroptera*. Methanol extract of this plant was used for study. Nine compounds were isolated from this plant. The novel compound (chebolic acid trimethyl ester) exhibited high radical scavenging activity (IC₅₀ 4.7 microg/mL). [14].

***Crataegus* spp.**

Family: Rosaceae, **Part used:** Fruit, leaves. **Medicinal uses:** It is used in heart diseases. **Pharmacological activity:** It is anti-oxidant and anti-inflammatory. **Study:** García *et al.*, reported the antioxidant activity of flowers of Mexican *Crataegus* spp [15].

***Lepidium sativum* linn**

Family: Brassicaceae, **Part used:** Roots. **Study:** Stüven *et al.*, reported the anti-oxidant activity of *Lepidium sativum* [16].

Humulus lupulus

Family: Cannabaceae, **Pharmacological activity:** It is antispasmodic, antibacterial, anti-inflammatory, oestrogenic, diuretic,

anodyne and hypnotic. **Study:** Vogel *et al.*, reported the antioxidative activity of minor prenylated chalcones from *Humulus lupulus* [17].

Vaccinium Myrtillus

Family: Ericaceae, **Part used:** Fruit, Leaf. **Medicinal uses:** It is used in diarrhea. **Study:** Laplaud *et al.*, reported the antioxidant action of *Vaccinium myrtillus* extract on human low density lipoproteins *in vitro* [18].

Aconitum napellus

Family: Ranunculaceae, **Medicinal uses:** It is used in gastritis, neuralgia, acute catarrh, ulcerated tonsils, croup and palpitation. **Pharmacological activity:** It is sedative, anodyne and febrifuge. **Study:** Luis *et al.*, reported the anti-oxidant activity of two flavonol glycosides from *Aconitum napellus*. Compound 1 is quercetin 3-O-(6-trans-caffeoyl)-beta-glucopyranosyl-(1-->2)-beta-glucopyranosyl-7-O-alpha-rhamnopyranoside and compound 2 is quercetin-3-sophoroside-7-rhamnopyranoside [19].

Agrimonia eupatoria

Family: Rosaceae, **Medicinal uses:** It is used in cough and diarrhea. **Pharmacological activity:** It is astringent, tonic and diuretic. **Study:** Venskutonis *et al.*, reported the anti-oxidant activity of *Agrimonia eupatoria* [20].

Nelumbo nucifera

Family: Nelumbonaceae, **Study:** Huan *et al.*, reported the antioxidant and hepatic protective effects of lotus root [21].

Scoparia dulcis

Medicinal uses: It is used in dysentery, diarrhea and hemorrhage. **Pharmacological activity:** It is homeostatic, stimulant, astringent and diuretic. **Study:** Leelavinothan *et al.*, has reported the protective role of *Scoparia dulcis* plant extract on brain antioxidant status and lipidperoxidation in STZ diabetic male Wistar rats [22].

Amaranthus hypochondriacus

Family: Amaranthaceae, **Medicinal uses:** It is used in menorrhagia, diarrhea, dysentery, hemorrhage, leucorrhea and sores. **Pharmacological activity:** It is astringent. **Study:** Lopez *et al.*, reported the antioxidant properties of *Amaranthus hypochondriacus* seeds and their effect on the liver of alcohol-treated rats [23].

Fumaria officinalis

Family: Papaveraceae, **Medicinal uses:** It is used in liver disorders, obstructive jaundice, arthritis, gall bladder stones, eczema and urticaria. **Pharmacological activity:** It is antioxidant and hepatoprotective. **Study:** Sengul *et al* reported the antioxidant activity of *Fumaria officinalis* [24].

Linaria vulgaris

Family: Scrophulariaceae, **Medicinal uses:** It is used in liver disorders, obstructive jaundice, edema, eczema and dermatitis. **Pharmacological activity:** It is antioxidant and hepatoprotective. **Study:** Anti-oxidant activity of this plant has been reported [25].

Alkanna tinctoria

Family: Boraginaceae, **Pharmacological activity:** It is emollient. **Study:** Assimopoulou *et al.*, reported the anti-oxidant activity of *Alkanna tinctoria* root extracts and their main constituents, hydroxynaphthoquinones [26].

Vitis vinifera

Family: Vitaceae, **Medicinal uses:** It is used in cough, palpitation and rheumatism. **Study:** In India, 11 grapes varieties were used for antioxidant activity. DPPH was used for anti-oxidant study. Flavonoids and phenolic compounds were determined. Most potent variety was cv. Mango. 2nd potency was of Sharad Seedless. Aqueous extract were less active than methanolic extract. Various polyphenols were determined on HPLC analysis. This study indicated that some varieties of *Vitis vinifera*

have activities that is due to phenolic and flavonoid compounds [27].

Parmelia perlata Ach

Family: Parmaliaceae, **Pharmacological activity:** It is astringent, aphrodisiac, nervine tonic, cardiac tonic and digestive. **Study:** Patil *et al.*, reported the antioxidant activity this plant [28].

Hazya stricta Dene

Family: Apocynaceae, **Parts used:** Fruit and leaves. **Medicinal uses:** It is used in sore throat, boils and eruptions. **Study:** It has anti-oxidant activity and is prescribed to treat cardiovascular disorders [29].

Viburnum opulus

Family: Adoxaceae, **Part used:** Bark. **Pharmacological activity:** It is relaxant, antispasmodic, sedative, and astringent. **Study:** Altun *et al* has reported the antioxidant activity of *Viburnum opulus* [30].

Brasica campestris L

Common name: Sarsoon, **Parts used:** Leaves. **Medicinal uses:** It is used in constipation and jaundice. **Study:** The oil is mixed/shaken with the leaves of *Saccharum grifithii* and prescribed to treat the jaundice [31].

Eruca sativa Miller

Common name: Taara Mira / Jamahoon, **Parts used:** Leaves, flowers, seeds, oil. **Medicinal uses:** It is used in constipation and piles. **Pharmacological activity:** It is antimicrobial. **Study:** Sarwar *et al* reported the antioxidant activity of this plant [32].

Bauhinia pupurea

Family: Leguminosae, **Part used:** Root, bark, flowers. **Medicinal uses:** It is used in diarrhea, boils and abscesses. **Pharmacological activity:** It is antioxidant and laxative. [33].

Cynodon dactylon

Common name: Khabal, **Parts used:** Root, leaves. **Medicinal uses:** It is used in burning sensation of feet, pimples of the face and fever. **Study:** Wang *et al.*,

reported the antioxidant activity of *Cynodon dactylon* [34].

Caesalpinia bonduc

Arabic name: Hajar al-Uqab, Hajar al-Wiladat, **Persian name:** Khaya-e-Iblees, Khurma-e-Abujahal, **Urdu and Hindi name:** Karanjwa, Gajga, **English name:** Bonduc Nut, Fever Nut. **Medicinal uses:** It is used in cardiovascular disorders, chronic fever, colic, epilepsy, skin diseases, intestinal worms and menstrual disorders. **Pharmacological activity:** It is resolvent, antipyretic, anti-inflammatory and anti-oxidant [35].

Eucalyptus camaldulensis Dehnh

Common name: Sufaida, **Parts used:** Leaves. **Medicinal uses:** It is used in flue. **Study:** Barra *et al.*, reported the anti-oxidant activity of this plant [36].

Abies pindrow Royle

Local name: Partal, **Part used:** Wood and leaves. **Medicinal uses:** It is used in gastric pain, constipation and abdominal bloating. **Pharmacological activity:** It is carminative. **Study:** It is anti-oxidant and can be prescribed to treat cardiovascular diseases [37].

Myristica fragrans

Family: Myristicaceae, **Medicinal uses:** It is used in flatulence, diarrhea, nausea and vomiting. **Pharmacological activity:** It is stimulant, digestive and aphrodisiac. **Study:** Akeem *et al.*, reported the antioxidant activity of this plant [38].

Urtica dioica

Family: Urticaceae, **Part used:** Aerial parts. **Pharmacological activity:** It is astringent, diuretic, nutritive, tonic, hypoglycemic and haemostatic. **Study:** Kanter *et al.*, reported the antioxidant activity of *Urtica dioica* [39].

Cinnamomum zeylanicum

Family: Lauraceae, **Part used:** Dried bark. **Medicinal uses:** It is used in flu, flatulence and thrush. **Pharmacological activity:** It is carminative, astringent, antispasmodic,

antibacterial and antifungal. **Study:** Mancini *et al.*, reported the anti-oxidant activity of *Cinnamomum Zeylanicum* extracts. For this study, b-carotene/linoleic acid system was used for measurement of anti-oxidant activity. Two controls were used for this experiment. One was with synthetic antioxidant (BHT, 100 ppm) and other without antioxidant. Anti-oxidant activity of etheric (0.69 mg) extract was 60%. Methanolic (0.88 mg) extract exhibited 95.5% activity. Aqueous extract (0.44 mg) showed 87.5% anti-oxidant activity. 80% anti-oxidant activity was exhibited by BHT control. Further phenolic compounds were identified from extracts [40].

Zea mays

Family: Poaceae, **Study:** Dewanto *et al.*, reported that processed sweet corn has antioxidant activity [41].

Vitex agnus castus

Family: Lamiaceae, **Pharmacological activity:** It is galactagogue. **Study:** Sağlam *et al.*, has reported the antioxidant activity of *Vitex agnus-castus* L. extracts [42].

Cocos nucifera Linn

Family: Arecaceae, **Medicinal uses:** It is used in backache, piles, itching and inflammations. **Pharmacological activity:** It is general tonic and vermifuge. **Study:** Mantena *et al.*, reported the antioxidant activity of *Cocos nucifera*. This plant was investigated for its ability to scavenge free radicals. Fresh sample of this plant scavenged 1,1-diphenyl-2-picrylhydrazyl (DPPH). Fresh juice was more active and activity was diminished significantly upon heat, acid or alkali treatment or dialysis [43].

CONCLUSION There is an urgent need for the development of novel drugs to treat degenerative disorders. Biological investigations into plants used traditionally for primary health care are one obvious way in which searching for new leading compounds should concentrate. Many

countries have vast experience in the use of medicinal plants and the required

knowledge spans many centuries.

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Table 1: List of medicinal plants having anti-oxidant activity

No	Plants	Family	References number
1	<i>Draba nemorosa</i>	Brassicaceae	44
2	<i>Commelina benghalensis</i>	Commelinaceae	45
3	<i>Syzygium cumini</i>	Myrtaceae	46
4	<i>Gmelina arborea</i>	Verbenaceae	47
5	<i>Artocarpus lacucha</i>	Moraceae	48
6	<i>Catalpa bignonioides</i>	Bignoniaceae	49
7	<i>Bergenia stracheyi</i>	Saxifragaceae	48
8	<i>Arnica Montana</i> L.	Compositae	50
9	<i>Allium cepa</i>	Amaryllidaceae	51
10	<i>Aegle marmelos</i>	Rutaceae	52
12	<i>Impatiens balsamina</i> L.	Balsaminaceae	53
13	<i>Evolvulus alsinoides</i> L.	Convolvulaceae	54
14	<i>Enydra fluctuans</i>	Asteraceae	55
15	<i>Cissus quadrangula</i> L.	Vitaceae	56
16	<i>Celastrus paniculatus</i> Willd.	Celastraceae	57
17	<i>Cassia occidentalis</i> L.	Caessalpiniaceae	58
18	<i>Boerhavia diffusa</i> L.	Nyctaginaceae	59
19	<i>Artemisia nilagirica</i>	Asteraceae	60
20	<i>Punica granatum</i>	Lythraceae	61
21	<i>Artemisia dracunculus</i>	Asteraceae	62
23	<i>Laurus nobilis</i>	Lauraceae	63
24	<i>Leptadenia pyrotechnica</i>	Apocynaceae	64
25	<i>Peumus boldus</i>	Monimiaceae	65
26	<i>Aloe vera</i>	Xanthorrhoeaceae	66
27	<i>Tamarix gallica</i> L.	Tamaricaceae	67
28	<i>Melaleuca alternifolia</i>	Myrtaceae	68
29	<i>Hypericum perforatum</i>	Hypericaceae	69
30	<i>Ampelopsis brevipedunculata</i>	Vitaceae	70
31	<i>Ficus microcarpa</i> L.	Moraceae	71
32	<i>Anthurium versicolor</i>	Araceae	72
33	<i>Syzygium cumini</i>	Myrtaceae	46
34	<i>Calliandra surinamensis</i>	Fabaceae	73
35	<i>Nigella sativa</i>	Ranunculaceae	74
36	<i>Rhodiola sachalinensis</i>	Crassulaceae	75
37	<i>Momordica Charantia</i>	Cucurbitaceae	76
38	<i>Vetiveria zizanioides</i>	Poaceae	77
39	<i>Lawsonia inermis</i>	Lythraceae	78,79